Does the location of wine cellars have significant impact on the evolution of Madeira Wine polyphenols?

Vanda Pereira [1,2], Maria J. Carvalho [2], Gabriel Pinto [2], Rita Fialho [2], João M. Gaspar [3,4], Marisela Pontes [4], Ana C. Pereira [2,5], Francisco Albuquerque [4], José C. Marques [1,2,3]

1 i3N, University of Aveiro – Portugal;

2 ISOPlexis – Sustainable Agriculture and Food Technology Center, University of Madeira – Portugal;

3 Faculty of Exact Sciences and Engineering, University of Madeira – Portugal;

4 Madeira Wine Company, S.A. – Portugal;

5 CIEPQPF, University of Coimbra – Portugal.

01 Goal

Evaluate whether there are significant differences in the evolution of Malvasia MWs during the aging by *canteiro* in cellars subject to different temperature and humidity conditions.

02 Introduction

Madeira wine (MW) is a well-known fortified wine (17–22% ABV) from the island of Madeira, Portugal. Unlike table wines, MWs benefits from a long aging period under thermo-oxidative conditions, during which it gains its unique and complex flavour. A broad study is ongoing and aims to assess if the differences in the storage conditions impacts significantly the progress of MWs during *canteiro* aging, including the polyphenols evolution.

Here we present the results of the first **12 months** of aging of Malvasia wines (sweet, > 111 g/L).

03 Experimental

Malvasia 2018 (M18) and 2008 (M08)

- MWs were distributed between cellars B and Z and placed into 225 L brand-new oak casks. Duplicates were considered (B_1/B_2 and Z_1/Z_2);
- Temperature and humidity data were sensor recorded;
- CIELab parameters >> UV-Vis (% Transmittance within 380 – 780 nm, $\Delta\lambda$= 5 nm; illuminant D65; standard observer at 10°);
- Non-anthocyanin polyphenols and furans >> RP-HPLC-DAD;
- Organic acids and sugars >> IEC-HPLC-DAD/RI.

04 Results

Humidity and temperature

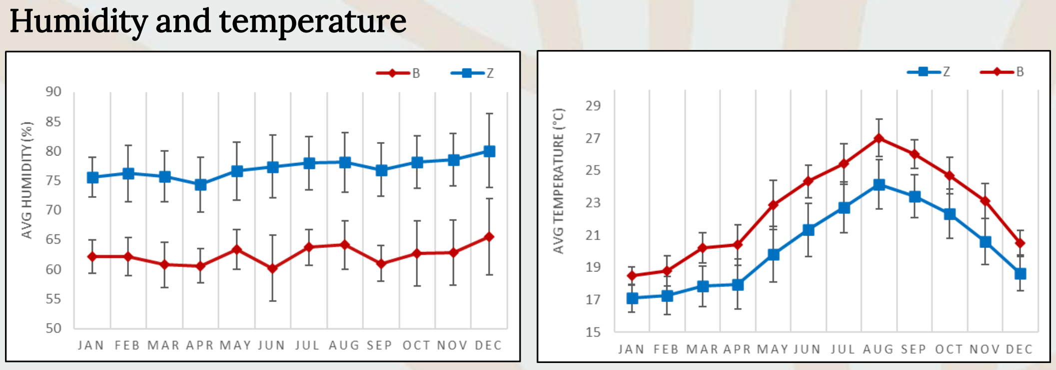

Fig. 1 – Monthly averages of A) humidity (%) and B) temperature (°C) of the wine cellars B and Z during 2019.

- Higher **temperatures** are registered in cellar B, ranging between 18-27°C. An average difference of about 2°C was observed between the cellars (2019);
- The values of the average monthly percentage of **humidity** registered in cellar B (60-65%) were quite lower than those registered in cellar Z (74 -80%). An average difference of about 15% was observed between both cellars.

CIELab parameters

- *a** and *b** values increase while *L** decreases during the oak-aging in both cellars. Greater variations are observed in cellar B, specially in younger wines (M18).

Polyphenols and furans

- The increase of hydroxybenzoates is noticeable in cellar B. An evident increase is observed in syringaldehyde, and ellagic and vanillic acids, probably because wine aging is being developed in brand-new oak casks;
- Older wines (M08) show an increase in hydroxycinnamates in both cellars, while the youngest (M18) show a noticeable decrease in cellar B;
- Furan's decrease is only observed in cellar Z, while variations are not observed in cellar B.

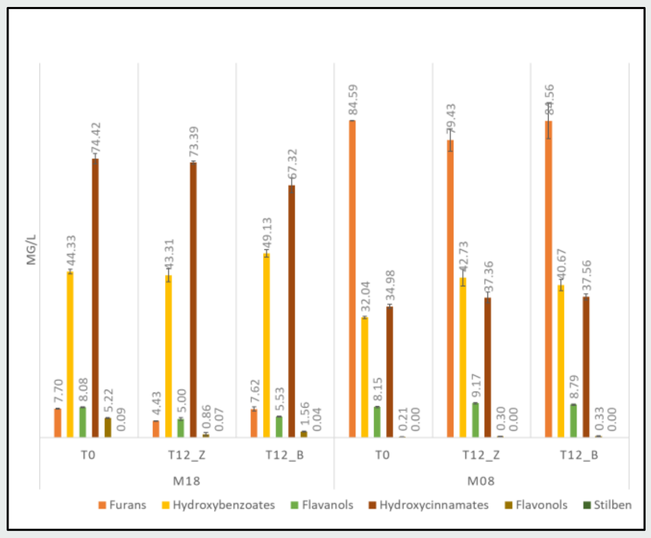

Fig. 2 – Evolution of the main polyphenolic families of M08 and M18 wines in the first 12 months of the experiment.

Multivariate analysis

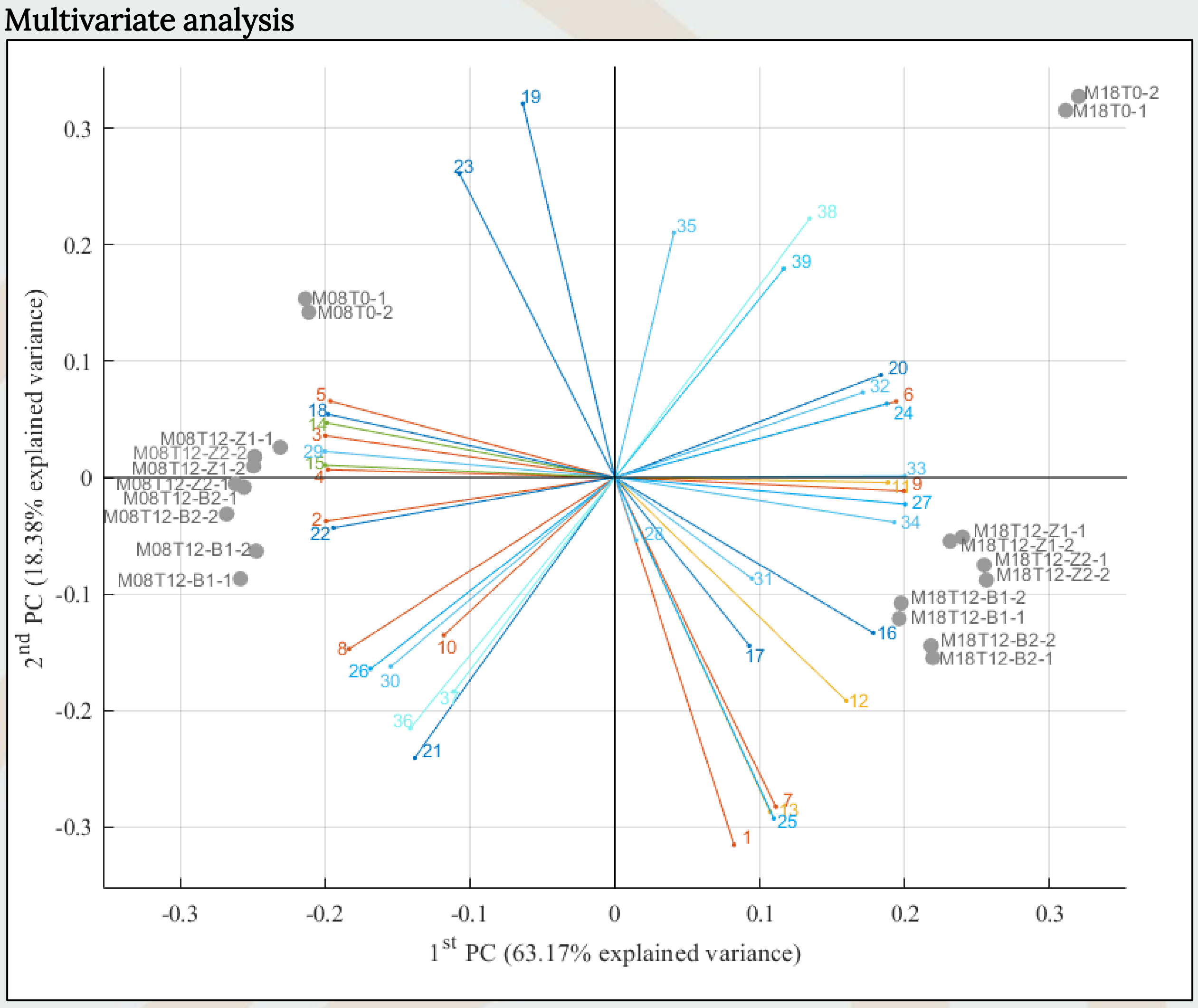

Fig. 3 – Biplot of the first two principal components regarding the Malvasia wines (M08 and M18) characterization data: 1 – Glucose; 2 – Fructose; 3 – Glycerol; 4 – Ethanol; 5 – Citric acid; 6 – Tartaric acid; 7 – Malic acid; 8 – Lactic acid; 9 – Formic acid; 10 – Acetic acid; 11 - *L**; 12 - *a**; 13 - b*; 14 – 5-Hydroxymethylfurfural; 15 – Furfural; 16 – Gallic acid; 17 – Protocatechuic acid; 18 – *p*-Hydroxybenzoic acid; 19 – Vanillic acid; 20 – Syringic acid; 21 – Vanillin; 22 – Syringaldehyde; 23 – Ellagic acid; 24 - (-)-Epigallocatechin; 25 - (+)-Catechin; 26 - (-)-Epigallocatechin gallate; 27 - (-)-Epicatechin; 28 – Caftaric acid; 29 - Caffeic acid; 30 – *p*-Coumaric acid; 31 – Ferrulic acid; 32 – Sinapic acid; 33 - *cis*-Coutaric; 34 - *trans*-Coutaric acid; 35 - *trans*-fertaric acid; 36 – Myricetin; 37 – Quercetin; 38 – Kaempferol; 39 - *trans*-Resveratrol

- The location of the cellars has a greater impact on the aging evolution of younger wines than on older ones;
- Differences between the same wine stored in the different cellars are more noticeable in younger wines.

Conclusion

After 12 months of aging in oak, there is evidence that young Madeira wines placed in warmer and drier cellars show signs of greater evolution. Storage conditions slightly impact the evolution of some polyphenols.

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05 Bibliography

- Pereira, A.C. et al., Modelling The Ageing Process: A Novel Strategy To Analyze The Wine Evolution Towards The Expected Features. Chemometrics And Intelligent Laboratory Systems, 154 (2016) 176-184.
- Carvalho, M.J. et al., Evaluation Of Wine Colour Under Accelerated And Oak-Cask Ageing Using CIELab And Chemometric Approaches, Food And Bioprocess Technology, 8 (2015) 2309–2318